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Timber Farming in the Cloquet District

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CONTENTS

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J. H. ALLISON and R. N. CUNNINGHAM

LOGGING in northeastern Minnesota no longer demands the labor of thousands of transient lumberjacks following woods work as their sole occupation and living together in huge camps. To a greater and greater extent, saw logs, pulpwood, and other forest products are supplied by farmers and small contract loggers. Even operators who own substantial reserves of standing timber and who have been accustomed to run their own camps are gradually turning to farm woods, and other woods in nonindustrial ownership, as a cheaper and more satisfactory source of raw material. Payments received for forest products have been a valuable addition to farm income; in many parts of the region, for several years past, they have been practically the sole source of income.

In spite of the mutually beneficial possibilities, few farmers and few industries in the region have taken the steps necessary to ensure the permanence of farm woodland operations. The available evidence indicates that the present rates and methods of cutting are causing continuous depletion of the supplies of the more valuable species. The study reported here was an effort to determine what might be done to improve the situation in one specific area in northeastern Minnesota, the Cloquet district.

This district was chosen mainly because Cloquet now provides one of the best markets in the United States for small-sized timbers such as can readily be produced in farm woodlots (fig. 1) or upon nonfarm-owned wooded wild lands lying in the neighborhood of occupied farms. Another reason for selecting the Cloquet district for study was the fact that its forest industries have been set up with the idea of seeking permanent operation. These industries form the major support of a thriving industrial and farming community, and their maintenance is important to nearby farmers entirely apart from the markets they offer for wood. A third reason was the probability that, owing to denser settlement and to competition for wood material, the effects of overcutting will be felt sooner in this district than in most other parts of northeastern Minnesota.

[1] Accepted for publication January 19, 1939.

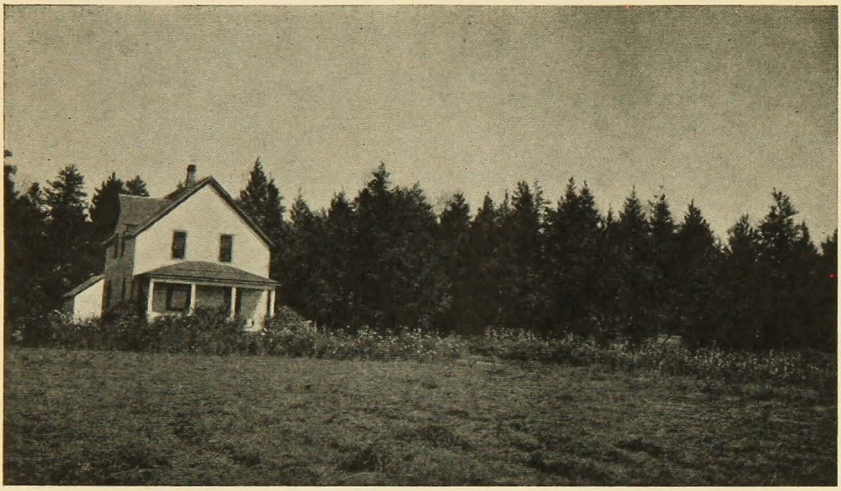


FIG. 1. FARMSTEAD NEAR IVERSON, MINNESOTA, WITH WOODLOT ADJOINING DWELLING
This woodlot contains considerable pine pulpwood and a few small saw logs.

The study of wood production by settlers in the vicinity of Cloquet was made during the summers of 1935 and 1936. The actual source of the wood used by the various industries at Cloquet was determined from company records, and direct information was obtained from the industries on logging and transportation costs, wood prices, selling practices. A large number of farmers were interviewed, also, and observations were made on many cutting areas to get a cross section of logging methods. The data were analyzed in the light of statistics already available from the national forest survey[2] as to timber stands, current growth, normal depletion, and other factors in Minnesota's forest situation. From the results of this study certain conclusions can be drawn as to the possibilities of improving farm-woodland management and the marketing of farm forest products in the Cloquet district.

DESCRIPTION OF DISTRICT

The district (fig. 2) covered by the study lies mainly within a 50-mile radius of Cloquet and includes, roughly, the area within which trucks can be used satisfactorily to transport wood to the Cloquet mills. It extends south to Isle and Hinckley, west to McGregor and Isle, north to Little Swan, Central Lakes, and Brimson, and east to Lake Superior and the Wisconsin line. Its gross area amounts to 3,124,226

[2] The Forest Situation in the Cloquet-Superior District, Minnesota. Forest Survey Economic Note No. 2. Lake States Forest Experiment Station. July 15, 1935.

acres, or a little less than 5,000 square miles. The district includes parts of five counties: Carlton, Lake, St. Louis, Aitkin, and Pine.

Agricultural Pattern

Peculiarities of climate, soil, and topography have resulted in a very spotty farm development in the Cloquet district. A few areas, notably in central Pine and northeastern Carlton counties, have good soil, and in these areas concentrated farming communities have developed. Much of the district is nonagricultural, however, by reason of rigorous climate combined with inferior soil or rough topography or both. The characteristic situation is a small patch of farming land surrounded by a large uncultivable area. Near Floodwood, tillable land occurs only in narrow strips along the streams, adjoined by muskeg areas. Altogether, one seventh of the entire district is swampland. In some parts of the district an otherwise productive soil is made untillable by the presence of innumerable small boulders; it may be possible to clear a forty here and there, but cultivation of large continuous fields is out of the question. Many of the small strips of good land along the shore of Lake Superior and along some of the streams draining into that lake break off abruptly into steep timbered bluffs.

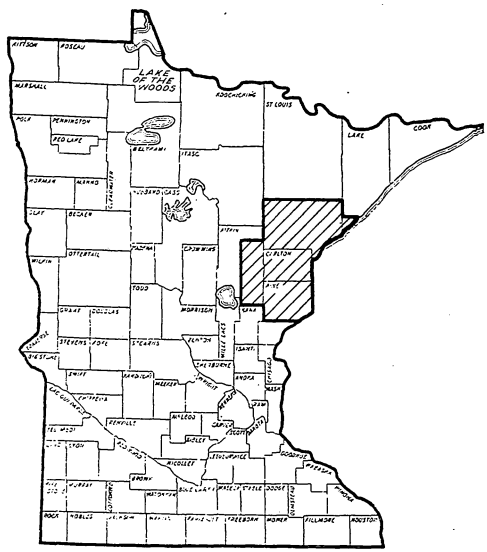


FIG. 2. LOCATION OF CLOQUET DISTRICT

Because of these soil and topographic characteristics, farm development is scattered and irregular,[3] and a number of farmers have settled on units too small for successful agricultural practice. Only 28.4 per cent of the land in the district is in farm ownership according to the 1935 census (table 1). Individual farm units total 10,279, with the

[3] Out of 138 General Land Office rural townships within the Cloquet district, only 14 have as much as 50 per cent of their land in farms and only 6 have 25 per cent or more of their land in actual cultivation, according to the Agricultural Census of 1935. The most fully utilized townships are Thompson in Carlton County and Hinckley, Dell Grove, and Partridge in Pine County.

average farm containing 86.3 acres. Of this total, 27.5 acres was cropland, 41.0 acres was woods, and 17.8 acres was cleared pasture or other open land.

Owing to the small acreage of cropland, gross income from agriculture averaged only about $1,200 a farm in 1929 and has doubtless been less in succeeding years. While taxes and some other expenses are less than in the southern part of the state, it is self-evident that this income is not adequate to maintain families at a satisfactory standard of living. In some localities this income is supplemented by road work and other outside employment, but such forms of supplementary income are not open to all.

Table 1. Land Use in Cloquet District as Revealed by Agricultural Census of 1935

County	Total area within district	Farms	Area of farms	Cropland	Farm woodland		
					Pastured	Not pastured	Total
	acres	number	acres	acres	acres	acres	acres
Pine	677,815	2,445	259,330	89,642	95,086	18,366	113,452
Aitkin	535,095	1,201	140,685	45,677	52,244	19,433	71,677
Carlton	550,092	2,594	234,389	76,365	70,065	31,992	102,057
St. Louis	1,313,228	3,829	240,407	74,306	83,465	42,601	126,066
Lake	47,996	210	12,656	3,546	5,340	2,834	8,174
Total	3,124,226	10,279	887,467	289,491	306,210	115,226	421,436

On many of the farms more man power is available than is required for farming and regular day work. The excess labor has to some extent been used in cutting and marketing forest products. Many of the farmers have had woods experience, and about 25 per cent of those recorded as selling wood to the Cloquet mills have trucks and the other equipment needed for cutting and delivering wood.

Forests

In the Cloquet district approximately three fourths of the land area (2,293,600 out of 3,124,226 acres) is classified as forest land. According to the 1935 census, 421,436 acres of woodland is included in farms. The remaining woodland, 1,872,164 acres, is made up of tracts of wild land held by lumber companies, banks, land companies, individuals, and the state and federal governments.

Because of the great variations in climate, soil, and topography, the original forests of this district were of a mixed character. The most valuable trees were the white and red pines, which grew on sandy and rocky land throughout the district. With the development of the pulp mills, the spruce that grew abundantly in the swamps also became highly prized. Stands of sugar maple and basswood were fairly common in the

FIG. 3. SMALL SECOND-GROWTH ASPEN AND BIRCH

It will be many years before any merchantable wood can be obtained from stands such as this.

southern part of the district and balsam fir, aspen, and paper birch were common farther north.

After the railroad was built to Duluth in 1870, lumbering developed on a large scale and soon swept the virgin forest away. Today nothing remains of the original forest but a few scattered groves in parks and on other recreational areas.

Logging was commonly followed by forest fires. Extensive portions of the district were burned by the Hinckley fire in 1894 and the Cloquet-Moose Lake fires in 1918. Even in recent years large fires have spread uncontrolled over much of the cut-over land. Until recently it was generally believed in the district that most of the land could be cleared and devoted to crops and pasture. This belief encouraged burning of unimproved land whenever conditions were favorable for burning. Most of the people now realize that a large part of this land is nonagricultural, but the tree growth has not yet recovered from the effects of the fires of the past.

After large-scale logging passed, there was still extensive cutting of the scattered remnants of forests by settlers and small operators. At present, trees in accessible locations are cut about as fast as they reach merchantable size.

The logging operations and the many fires have left the forest cover badly depleted. The forest now consists, to a large extent, of small growth of the aspen–paper-birch type and jack pine on the uplands and stunted spruce and tamarack in the swamps (table 2; figs. 3, 4, and 5).

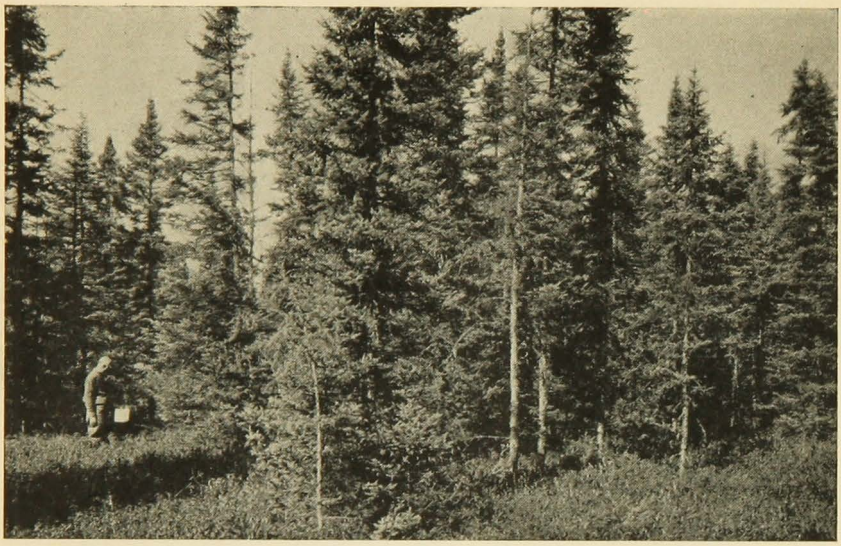


FIG. 4. BLACK SPRUCE AND TAMARACK IN SWAMP

Because of the large amount of stagnant water in this swamp, both the spruce and the tamarack are growing slowly. Only Christmas trees, conversion wood, and a small amount of inferior pulpwood can be obtained from stands such as this.

The aspen–paper-birch type, consisting largely of popple and paper birch, is the most widespread. Typically, the aspen forests consist of young sprout stands containing relatively little merchantable wood. In the southern part of the district the aspen forests that originated after the 1918 fires are now reaching the small pole stage and with proper care would soon become merchantable. Many of the aspen forests that have come in on land originally covered with spruce and balsam fir already have a few trees of these species as an understory and could be gradually converted to coniferous stands by proper cutting methods.

The black spruce, tamarack, and cedar swamp forests in the Cloquet district are of two kinds. One is the naturally productive swamp that

Table 2. Acreage of Principal Forest Types in Cloquet District

Forest type	Total area	Saw-timber area	Cordwood area	Restocking area
	acres	acres	acres	acres
Aspen paper birch	866,200	7,800	84,700	773,700
Spruce, tamarack, cedar swamp	346,800	.....	29,700	317,100
Pine (principally jack pine)	27,600	1,600	11,000	15,000
Spruce-balsam (uplands)	97,300	8,600	19,600	69,100
Hardwoods	167,900	18,800	30,600	118,500
All types	1,545,800	32,900	210,900	1,302,000
Nonstocked	747,800			
Total forest-land area	2,293,600			

has been reduced to a cutover status by repeated operations for poles, posts, and pulpwood. This kind covers two thirds, or 227,800 acres, of the swamp-forest area. The other, covering 119,000 acres, is the essentially nonproductive stagnant bog that supports trees only four or five inches in diameter at breast height (4½ feet from the ground) even after one hundred or two hundred years' growth. Typical nonproductive bogs of this kind may be seen in the neighborhood of Meadowlands and Toivola. If given reasonable care and protection, the cutover productive areas will recover in a comparatively short time. There are no practical means of obtaining satisfactory yields from the stagnant bogs.

The jack pine type, which has replaced the white and the red (Norway) pine on sandy lands, has suffered greatly from premature cutting and fires. Most of the stands are understocked and contain many trees of poor form and quality. The few tall, dense stands in northern Pine County and at the Cloquet Forest Experiment Station of the University

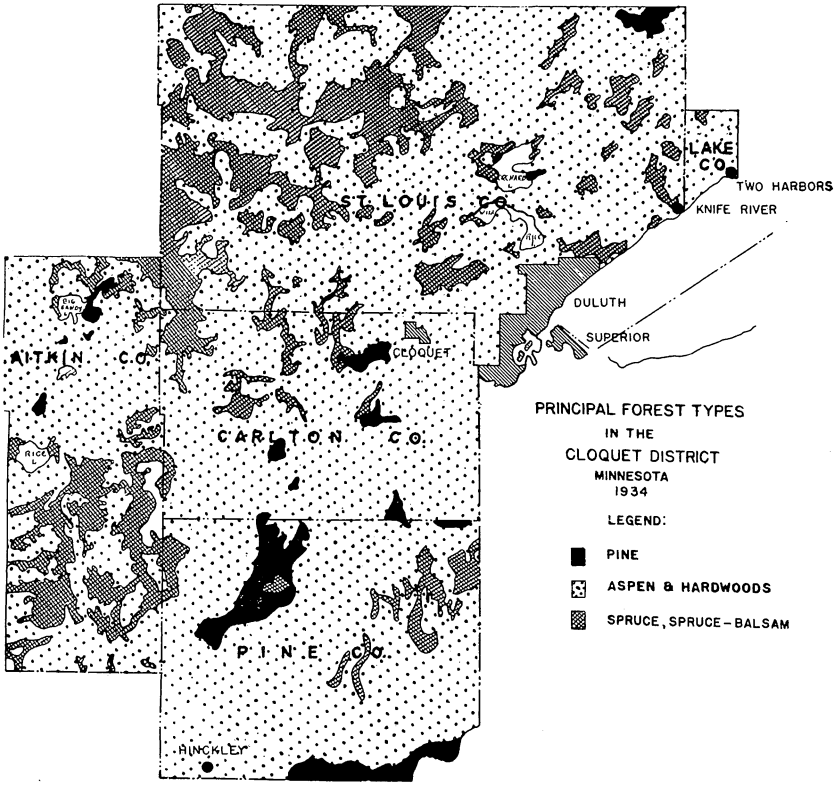


FIG. 5. PRINCIPAL FOREST TYPES IN CLOQUET DISTRICT
Note the predominance of aspen and other hardwood types.

of Minnesota show that with good protection and proper cutting it is possible to grow large volumes of good timber of this type.

Stands of the upland spruce–balsam-fir type are remnants of forests that originally contained quantities of valuable white spruce, white pine, and balsam fir, and numerous cedar poles. After many cullings and partial burnings, they retain little pine or spruce. The remaining balsam fir and cedar is more or less defective, and inferior hardwoods such as black ash, balsam poplar, soft maple, and elm often predominate. Before such stands can be made highly productive, much of this inferior material will have to be removed.

Present hardwood forests, though the trees average somewhat larger than in other types, are seldom of a quality to be readily merchantable. Most of the trees are short and poorly formed, and not a few are defective. However, they supply local needs for firewood, fence posts, and maple sirup.

The district's best woodlot stands are found in its southwestern corner; here the ratio of coniferous to broadleaved timber was originally lower than elsewhere in the district, and hence cutting has been less severe. Also, this part of the district has been subjected to less severe burning than have the others, partly because the farmers living in it take a greater interest in their farm woods.

Markets for Forest Products

One distinct advantage possessed by the Cloquet area is its diversified and more or less integrated group of wood-using industries. In the sawmills, pulp mills, match factory, and other minor mills exists a market for many kinds of wood not salable elsewhere in the state. However, there are serious problems connected with supplying these industries from local sources. To understand these problems, it is necessary to consider the nature of the industries and the special qualities they require in their wood supplies.

Sawmills

Cloquet is no longer a large pine lumber center. Its sawmilling history, which started in 1878 with the construction of a small water-power mill, came to a virtual close in 1936 when the last large sawmill was dismantled. The large-scale industry survived the exhaustion of local pine supplies some twenty-five years ago. It survived the 1918 fires, but in the face of increasing logging and transportation costs it could not survive the fall in stumpage and lumber prices which came with the depression in 1929.

Nevertheless, there are in Cloquet and the surrounding district nearly one hundred small sawmills and a few cutting up to 5 to 10 million board feet of lumber a year.

The typical mill is a small portable outfit cutting 100,000 feet or less of rough lumber for farm use and 1,000 to 3,000 ties for the railroads.

Few of these mills make a practice of buying logs on scale. In the majority of cases they are cutting timber belonging to the owner or are custom-sawing for farmers. The common charge for custom-sawing when the study was made was $6 per thousand. Where timber is purchased, usually a lump sum is offered for all material on a 40-acre tract or some amount such as 10 cents a cut may be offered for ties with the understanding that the operator will get all side lumber and fuel wood in addition.

There are several medium-sized band mills within or adjacent to the unit which commonly buy logs from farmers. The mills at Tower,

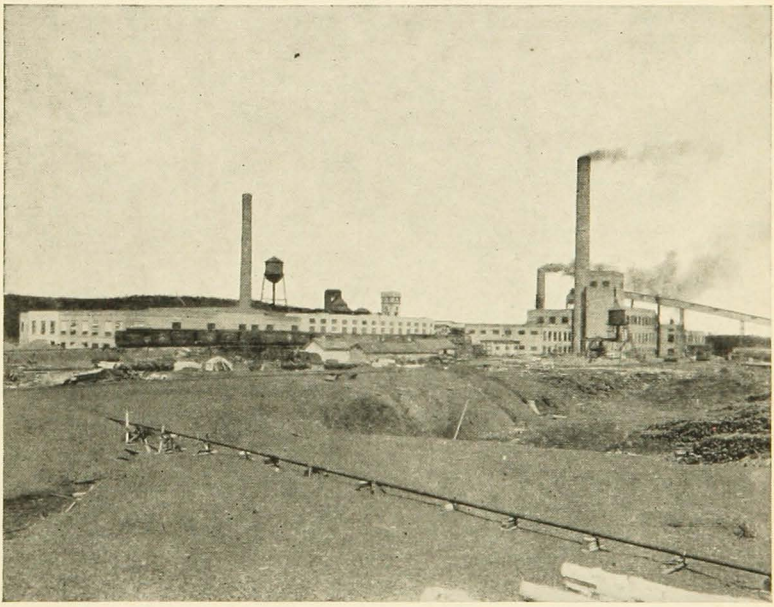


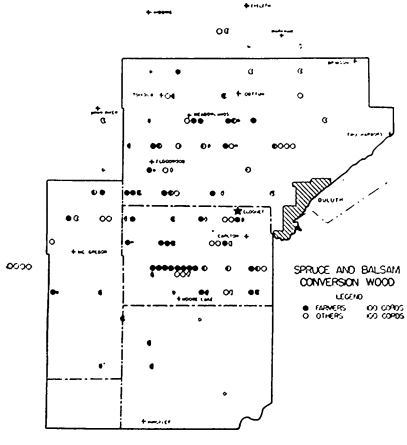
FIG. 6. THE NORTHWEST PAPER COMPANY'S MILL AT CLOQUET, MINNESOTA
The most important outlet for pulpwood produced within the Cloquet district.

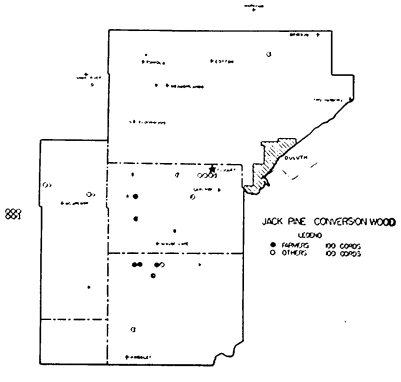
Virginia, Duluth, and Cloquet in particular will take eight-foot or longer logs of white pine, red pine, jack pine, balsam, and aspen. Average prices paid are $12 to $15 per thousand for ordinary grades up to $25 or more for best quality pine.

Based upon average production, the remaining sawmills will need 20 to 30 million board feet of saw timber each year. In the past, at least 50 per cent of the logs cut for lumber have been white or red pine, but increasing use is now being made of aspen, paper birch, balsam fir, spruce, jack pine, oak, basswood, cedar, and tamarack. Even a little ash, elm, and maple is being sawed in a few mills.

Pulp and Paper Mills

Cloquet has had a pulp and paper mill since 1899. The first unit was a groundwood plant manufacturing newsprint paper. A sulphite plant was added in 1915. In 1921 a new soda-sulphate-sodite plant was set up to utilize jack pine, aspen, and balsam fir. In 1936, the mills produced 864 tons of groundwood, 25,530 tons of sulphite, 13,260 tons of soda, 2,000 tons of sodite, and 16,700 tons of kraft pulps. For the manufacture of these pulps a total of 103,110 cords of wood was purchased in that year divided as follows: peeled spruce, 33,835 cords; rough spruce, 9,071 cords; peeled aspen, 22,638 cords; rough aspen, 434 cords; peeled jack pine, 6,308 cords; rough jack pine, 28,265 cords; peeled balsam fir, 1,689 cords, and rough balsam fir, 870 cords.





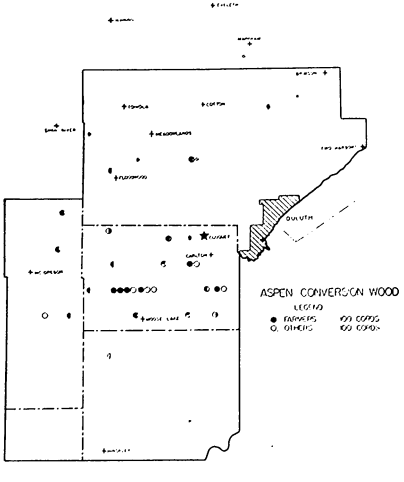


FIG. 7. SOURCES OF WOOD FOR WOOD-CONVERSION PLANT

It is the paper company's policy to buy as much of their wood as possible from farmers and local jobbers. During the five years, 1932-1936, from 15 to 33 per cent was obtained from farmers and small operators within this area. The proportion has been increasing.

Pulpwood must be reasonably smooth and free from rot. It is

bought in eight-foot (100-inch) lengths, either peeled or rough. The minimum acceptable diameters (inside bark at the small end of the stick) are as follows:

	Rough (inches)	Peeled (inches)
Spruce	4	3½
Jack pine	4½	.....
Balsam fir	5	3½
Aspen	5	5

The average prices paid f.o.b. mill 1932-1937 are given in table 3.

A small pulpmill is also operated in conjunction with the match factory at Cloquet. About 3,500 cords of spruce are used annually in manufacture of paper plates and similar specialties.

A third pulping plant is operated at Cloquet to produce insulation felts and fiber boards. This company uses 30,000 to 40,000 cords of spruce, balsam fir, jack pine, and aspen. This material, locally known as "conversion wood," is mostly too small or too poor to be used in the manufacture of paper. Jack pine, aspen, and balsam fir are accepted to a 3-inch and spruce to a 2½-inch minimum diameter inside bark at the small end. The wood need not be peeled. Prices, of course, are lower than for regular pulpwood. The usual rate is about $4.50 a cord—somewhat more for spruce, somewhat less for aspen. This low price precludes rail shipment; practically everything comes in by truck from the Cloquet area itself (figure 7).

Wood producers in the Cloquet area also have access to Wisconsin markets in sale of spruce and jack pine pulpwood. Freight to Stevens Point runs to $3 to $4 a cord, but there is enough differential in prices at Wisconsin mills to make up for this added expense.

Table 3. Average Delivered Prices per Cord of Pulpwood at Cloquet, 1932-1937

Kind of wood	1932	1933	1934	1935	1936	1937
Spruce						
Peeled	$7.11	$7.54	$9.95	$10.21	$11.06	$13.00
Rough	6.29	5.45	7.20	7.17	7.50	8.25
Balsam						
Peeled	5.00	5.12	5.98	6.00	6.12	.....
Rough	.....	5.00	5.00	5.00	5.00	.....
Aspen						
Peeled	5.00	5.20	5.47	5.48	5.03	7.00
Rough	.....	4.50	4.50	.....	.....	5.50
Jack pine						
Peeled	4.50	6.00	.....	5.59	5.50	7.50
Rough	4.39	4.09	4.50	4.50	4.49	5.50
Chip	.....	4.00	3.50	.....	3.50	.....
Average	$5.61	$4.97	$5.83	$6.17	$6.66	.....

Match Factories

There are two match factories in the area, one at Cloquet and one at Duluth. Only the Cloquet plant uses locally grown wood, and this company also manufactures clothespins and a few other items. In a typical year, November 1, 1934 to October 31, 1935, this mill utilized 3,400 cords of paper birch and 11,000 cords of aspen. Figure 8 shows the source of most of this wood.

Aspen match bolts are 53½ inches long and at least eight inches in diameter inside bark at the small end. They must be smooth and straight and have at least four inches of clear wood around the outside, that is,

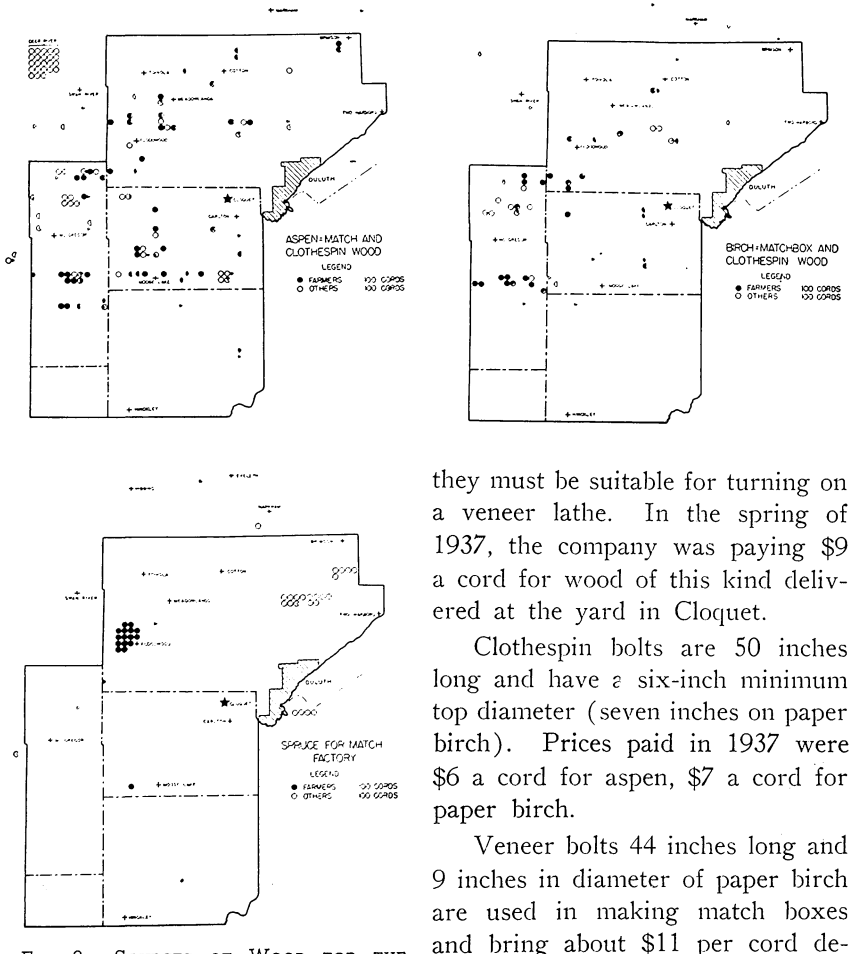


FIG. 8. SOURCES OF WOOD FOR THE MATCH AND CLOTHESPIN FACTORY

they must be suitable for turning on a veneer lathe. In the spring of 1937, the company was paying $9 a cord for wood of this kind delivered at the yard in Cloquet.

Clothespin bolts are 50 inches long and have a six-inch minimum top diameter (seven inches on paper birch). Prices paid in 1937 were $6 a cord for aspen, $7 a cord for paper birch.

Veneer bolts 44 inches long and 9 inches in diameter of paper birch are used in making match boxes and bring about $11 per cord delivered.

Miscellaneous Markets

There are four small lath mills and five shingle mills in the area, but these do not offer much of an outlet for farm timber. The few lath mills that buy bolts pay only $3.50 to $4.00 a cord for balsam fir and aspen. This material must be sufficiently sound and straight to make three- and four-foot lath and fence pickets. The shingle mills utilize mainly woods waste after pole and tie operations.

Just north of the area are the Mesabi and Vermillion iron ranges and just to the west is the Cuyuna Range, where mine ties, timbers, and lagging can be sold by local producers. Normal consumption is about 10 million board feet of timbers and 23,000 cords of poles and lagging. Mine timbers, which are usually pine or tamarack, are 12 to 14 inches in top diameter and bring about $35 a thousand board feet. Poles of spruce and tamarack with 3- to 5-inch top and 8 or 16 feet long sell for about 1½ cents a linear foot. Lagging, mostly cedar, sells for about $7 for a cord 6x4x8 feet.

There is periodic demand for piling at Duluth and other lake ports. Norway pine is favored, but other softwoods and some oak are used. Most piling must be straight and sound with 7-inch minimum top diameter. Good sticks bring $3 to $5 each at the water front.

Hewed ties can be sold at the mines and some railroad points. Prices vary with the demand and with the grade of ties. The usual range is from 40 cents to $1 each. Railroads ordinarily will accept ties only in carload lots.

Cedar posts can be sold locally for 10 to 18 cents apiece or can be trucked to southern Minnesota where they should bring 20 to 25 cents apiece. The usual post is 7 feet, with a 4-inch minimum top. Railroads offer probably the best market.

The value of firewood varies a great deal with quality and location. Dry birch, pine, or tamarack delivered to dealers in Cloquet or Duluth usually brings $4 to $5 per cord. Most farmers in the area use some wood themselves, the average farm consumption being somewhat more than ten cords.

There is usually a fairly good demand in this area for Christmas trees, but the product is so handled that few farmers can participate in the production. A few large operators buy the cutting rights on certain swamplands and make a clean cut of the salable material. There is no provision for assembling trees from thinnings or partial cuttings which might be made in the farm woods.

FARMER'S PLACE IN WOOD PRODUCTION

A study of delivery records for the year 1935 indicated that about sixty thousand cords or a little less than half the cordwood used by Cloquet industries was obtained from within the district under consid-

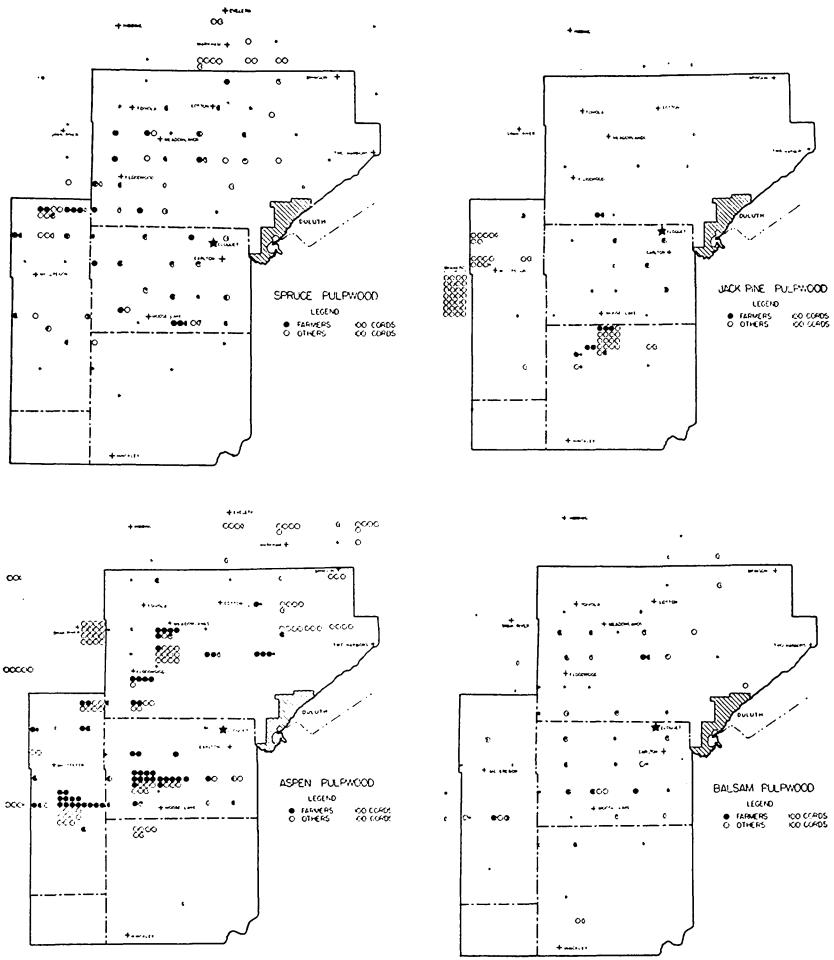


FIG. 9. SOURCES OF WOOD FOR THE PAPER MILL

eration. The other half of the cordwood and most of the saw-log material was brought in by rail from operations on company-owned stumpage within the national forests and the Indian reservation, or was wood purchased from farmers around Brainerd, Gheen, and elsewhere.

Some 750 individuals participated in the delivery of wood from the Cloquet area in 1935. Of these, 425 were members of families whose principal occupation was farming. This farmer group brought in approximately 40 per cent of the local wood, or an average of 56.2 cords each, for which they received $138,950, or about $327 each. The average receipts of two thirds of them were close to $500; those of the remaining third, who sold less than 10 cords each, were somewhat less than $70.

During 1935, 33 per cent of the paper company's wood was supplied by the Cloquet district. This wood brought $152,000 delivered at the mill, of which amount $70,000 or 46 per cent was traced directly to farm families. Some 300 farmers delivered wood. One third of them brought in less than 5 cords each, the smallest single delivery being 0.7 cord of spruce. On the average, each farmer delivered 37.2 cords and received $218.20 for it. The geographic origin of this wood is shown in figure 9.

About half of the 25,160 cords of wood purchased by the wood-conversion company during the 1934-1935 logging year was traced to farm families. The average sale was 35.1 cords for $148.80. The smallest sale involved 1.3 cords at $4 a cord.

The match and clothespin factory obtained 75 per cent of the wood it used in 1935 from within the Cloquet area. About half of this came from farmers. The farmers produced most of the smaller-sized aspen and birch, but were unable to supply the needed high-quality veneer bolts and peeled spruce pulpwood. Consequently they received less than half of the money income from locally produced wood. It was necessary for the company to go outside of the area to find some of the better-grade aspen, paper birch, and spruce. Farmers, however, received about $50,000 or a little more than $7.50 a cord for the wood brought in. This is a considerably higher average unit price than obtained for other wood products at Cloquet. The average farmer marketed 40.6 cords for which he received $306.37.

No doubt a considerable portion of the 36,000 cords delivered by the 325 truckers and small-timber jobbers came originally from farms, or at least farmers participated in the logging. These small operators cut in the winter time and commonly use farm boys for cutting and skidding rather than regular lumberjacks. The average contract was for only 111 cords for which the average payment was $727. In many cases these deliveries were from stores which acted as jobbers and bankers for groups of local farmers.

By no means all of the farmer-produced wood came from farm woodlots. Much of it was obtained from absentee-owned land, tax-delinquent land, and land owned by the state. Of 20,710 cords of local wood that came into the paper mill in 1935, 69 per cent came from property that, according to the assessor's records, had no farm improvements. No attempt was made to determine how much of this was obtained by purchase and how much in trespass.

From the standpoint of the industries, there are many reasons for encouraging production of wood on farms and other nearby areas. When its logging operations on the Nett Lake Indian Reservation are completed in a year or two, the paper company will have to depend on local wood or haul timber at considerable expense from Cook County and Canada. Wood from northern Cook County must bear a high transportation cost, amounting in some cases to $4 or $5 per cord.

Logging costs are also higher on these lands. Canadian supplies are uncertain and also involve long freight hauls. The wood conversion company can not obtain wood from areas beyond a 40-mile radius without greatly increasing its costs. A 20-mile additional haul will add roughly 25 per cent to the cost of its raw materials.[4]

In some respects it is advantageous to companies to obtain wood from farmers rather than from small timber operators. Anyone in the district who employs six or more men must conform to the union scale of wages, whereas farmers working at their own convenience usually figure their time at a lower rate.[5]

Expansion of the local wood business should also be of interest to the farmers. As has been pointed out, many of them have some spare time in the winter and some land on their farms which is not suited to the production of crops. Most of them could make good use of a little additional cash income.

It is quite obvious from a study of conditions in the area that neither group is making the best use of its opportunities. The industries are doing little to perpetuate the local timber supplies and few of the farmers are handling their woodlands on a constructive basis. The fact that only about 4 per cent of the farmers in the area brought wood to the Cloquet industries in 1935 and that a majority of this wood was cut on other

[4] During the depression, transportation costs have averaged about 5 cents per cord per mile up to about 50 or 60 miles; within a 20-mile radius, wood could be hauled in for $1 plus a little for loading and unloading; at 40 miles, the charges have averaged $2, and so on. Beyond 50 miles most wood could be more efficiently shipped by rail. The rail charge for a cord of 3,300 pounds from McGregor (45 miles) is $1.98, from Meadowlands (45) $2.15, from Gheen (100 miles) $2.48, from Bemidji (150 miles) $3.30. The charges for rail hauls do not increase proportionately with distance. Once the wood is loaded on cars, a 100-mile haul does not cost much more than a 40-mile haul. Wood can be hauled from Gheen to the pulp mills of eastern Wisconsin for $2 per cord more than the charge to Cloquet. Thus, in buying wood along the railroads, Cloquet industries come into direct competition with outside mills.

[5] Standard rates of pay as set in the November 1937 contract between the Timber and Sawmill Workers Union, Local No. 29, and the operators, for ordinary woods labor are as follows:

$75.00 per 26 working-day month of 8 hours per day ($2.885 per day, or 36.1 cents per hour) with, usually, time and a half for overtime;

$3.00 per cord for rough spruce, including stacking in piles of not less than one-quarter cord each;

for *piecework* cutting of rough pulpwood, including making skrip roads and bunching sticks along that roadway—

for spruce and balsam fir

3 cents per stick for tops 4 to 7 inches in diameter inside bark

5 cents per stick for tops 7 to 10 inches in diameter inside bark

8 cents per stick for tops 10 inches and more in diameter inside bark,

for jack pine

3½ cents per stick for tops 5 to 8 inches in diameter inside bark

7 cents per stick for tops 8 inches and more in diameter inside bark,

for aspen

4 cents per stick for tops 5 inches and more in diameter inside bark,

for peeled aspen

6 cents per stick for tops 5 inches and more in diameter inside bark.

Appropriately higher prices are specified for peeled spruce, balsam fir, and jack pine. These wage schedules are considerably higher than those in effect in 1935.

than farmland testifies to the poor condition of the average farm woodlot.

An attempt to examine the underlying difficulties in the situation and to make a few suggestions toward the solution of the problems involved follows.

DEFECTS IN THE PRESENT SITUATION

The prospect for maintaining a permanent farm-forest enterprise in the Cloquet district is clouded by several features pertaining to stand conditions and by certain economic influences and management practices.

Poor Condition of Woodlands

Because of recent cutting and extensive damage by repeated fires, the quantity of merchantable timber now available in this district is limited. Only 1.5 per cent of the forest land now bears timber of sawlog size, and less than 10 per cent bears timber of cordwood size. Nearly 89 per cent of the forest land is restocking or is temporarily deforested.

The merchantable saw timber is estimated to total only 270 million board feet, at most a 10- to 15-year supply for the local industries (table 4). Moreover, much of this saw timber is so thinly scattered over large areas of land that it cannot economically be logged, either at the present

Table 4. Merchantable Timber Volumes in Cloquet District, by Forest Cover Type*

Forest cover type	Area	Saw timber		Additional pulpwood	
		Volume per acre	Total volume	Volume per acre	Total volume
	acres	bd. ft.	M bd. ft.	cords	cords
Aspen and nonstocked	1,614,000	62	99,700	0.22	342,000
Spruce, tamarack, and cedar swamp	346,800	20	6,830	0.15	52,000
Pine	27,600	868	23,970	1.34	37,000
Spruce-balsam (upland)	97,300	593	57,730	2.23	217,000
Hardwood	167,900	505	84,760	0.28	47,000
Total	2,293,600	119	272,990	0.31	705,000

* See footnote page 4.

time or in the near future. The same is true of the pulpwood, which totals only 700,000 cords, equivalent to about a five-year supply for the Cloquet mills.

While the supplies of good saw timber and high-grade pulpwood are limited, there is an abundance of low-grade cordwood.

A great deal of the aspen, particularly on pine land, becomes defective at an early age. Trees only 6-8 inches in diameter may show incipient heart rot, and even smaller trees are marred by black surface cankers. Aspen of this size growing on the more fertile soils, where

under normal conditions the trees should remain sound until they reach a much larger diameter, is often found to be as defective as that growing on pine lands, because of injuries inflicted by frequent and extensive fire (fig. 10). Material of this kind cannot be used for matches, veneer, or high-grade pulp, and has obvious disadvantages for other fiber products. Nevertheless, it should be put to some use, if only for fuel.

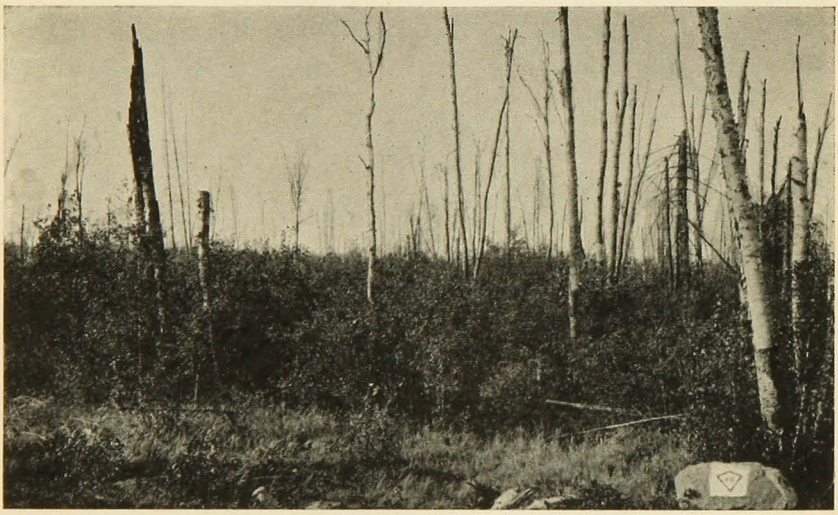


FIG. 10. EFFECT OF FREQUENT BURNING UPON ASPEN-BIRCH TYPE

It will be many years before any merchantable timber is produced upon wild land such as this.

Proper forest management will be difficult until such a use is found. Better fire protection, development of thriftier and denser stands, and encouragement of other species should eventually reduce the quantity of low-grade aspen.

Balsam fir, likewise, is commonly defective in the Cloquet district. Trees more than 9 or 10 inches in diameter are usually hollow-butted and unless the stands are cut before they reach 70 or 80 years of age the loss from cull and wind throw is heavy. Only sound balsam is accepted by the paper mills.

Tamarack has been severely depleted by sawfly epidemics. Most of the insect-killed commercial tamarack timber could be salvaged if there were a market for it; at present, however, very little tamarack is used by the Cloquet industries.

Most of the older stands of pine, balsam, aspen, and hardwoods are in need of early improvement cuttings to get rid of overmature, insect- or rot-infested, and otherwise defective trees, and to give the land a chance to restock to valuable species.

A few stands in which natural growth is too dense or aspen is suppressing more valuable pine and spruce might profitably be thinned. But thinnings or improvement cuttings in these stands would produce large quantities of rough wood, for which there is little market at present.

Premature Cutting and Other Undesirable Practices

The typical area of restocking forest land in the Cloquet district supports approximately four hundred to six hundred saplings and small poles an acre, mostly from one to five inches in diameter at breast height (table 5). Usually there are from 1 to 25 six-inch or larger trees per acre. According to common practice, however, trees large enough to make a pulp stick are cut at the earliest possible time. Thus the woods are kept permanently in a sapling stage (fig. 11).

Table 5. Average Number of Trees of Various Diameters per Acre on Restocking Land, for Four Principal Types

Diameter at breast height in inches	Average number of trees per acre on restocking land			
	Aspen type	Black spruce swamp type	Jack pine type	Spruce-balsam type
2	327	316	332	231
4	87	158	267	99
6	12	15	23	26
8	2	1	3	7
10+	1	.....	1	4
Total	429	590	626	367

This premature cutting is inefficient from a logging standpoint. It requires opening up and maintaining woods roads for cuts of very small volume. Cutting, limbing, and piling a cord takes more time and effort with this small wood than with larger timber, particularly if the wood is peeled. Loading and unloading also costs slightly more for this small wood than for larger wood.

Not only is cost per cord more, but average price received is usually less for the small timber. Spruce conversion wood having a 2½ to 3½-inch minimum diameter brought only about $5 per cord in 1937, while spruce pulpwood of a 4-inch minimum diameter brought $8.25 per cord. Unpeeled aspen pulpwood with a 5-inch minimum diameter brought $5.50 per cord, while 8- to 12-inch aspen bolts could be sold to the match factory for $9 per cord. Similarly 7-inch paper birch bolts sold for $7 per cord while 9-inch ones brought $11.

Such premature cutting causes further loss to the timberland owner because it involves sacrifice of much of the potential growth. On medium sites it might take well-stocked black spruce 40 years to reach a minimum pulpwood size of five inches in breast-height diameter, with

a volume of six cords an acre. Thereafter, the growth in merchantable volume would be rapid, the average stand adding a merchantable volume of eight cords an acre in the next ten years. In other words, *annual growth in pulpwood would for a considerable number of years be more than five times as great after the stand reached minimum pulpwood size as it was before.*

Unfortunately, many farmers are not sufficiently well informed regarding forest crops to recognize the potential value of thrifty trees now 2 or 3 inches in diameter, and so permit them to be injured during logging operations or by brush fires.

Grazing is also detrimental to the woods. Of the 421,436 acres of farm woods in the Cloquet district in 1935, 306,210 acres, or about 75 per cent were pastured. While pasturing in these northern woods is

FIG. 11. JACK PINE STAND THIRTY YEARS OLD LOCATED ON THE UNIVERSITY OF MINNESOTA FOREST EXPERIMENT STATION NEAR CLOQUET, MINNESOTA

This stand would now furnish a large quantity of conversion wood but only a few sticks of pulpwood per acre. Holding it uncut for another 10 or 15 years would greatly increase the proportion of pulpwood.

not usually so heavy or so destructive as in the farm woods of southern Minnesota, it does retard reproduction and in some cases causes practical deforestation. In general, timber reproduction and pasturing do not go together; either the land should be cleared to make good pasture, or it should be protected to make good woods.

So far, there has been practically no forest planting on private lands within the Cloquet district. Planting stock has not been available to

farmers at low prices, and even if it were, most of the farmers living within the district have not believed that present or prospective stumpage prices would justify planting. Finally, most of the few farmers who do know how to manage forest land and would be interested in developing their woodlots do not have the capital resources necessary to make a start. Others, who do have the necessary resources, do not know just what should be done.

Low Stumpage Prices

One factor that has tended to discourage forest management during the past few years is the small spread between the delivered price for wood and the minimum costs of cutting and delivering the wood—in other words, the small margin left for stumpage. A common arrangement in connection with the transportation of "conversion" and other low-priced wood from the woods to the mill is for the trucker to get half the delivered price. A similar arrangement also often pertains to the higher-priced wood coming from the more distant parts of the area. Commonly, after completing such a contract the farmer finds that his check amounts only to low wages for himself, with practically nothing left for the value of the standing timber. This situation has been a product of the general hard times which brought about very keen competition among the wood-pulp and wood-fiber products manufacturers throughout the world, together with a marked reduction in the prices for such products, and the competition between farmers and jobbers for the limited market available during the hard times.

At 1935 prices a farmer living 30 or 40 miles from Cloquet, if he allowed himself and his helpers 60 to 80 per cent of the amount usually paid in the regular logging camps for cutting and peeling, would usually receive only 25 cents to $1 per cord for stumpage and profit. A few typical examples will be given.

A farmer near Floodwood cutting rough spruce for the paper mill in 1935 paid 3 cents per stick, or about $2.00 per cord, for cutting, 50 cents for skidding, $1.50 for hauling and loading on cars, $1.67 for freight to Cloquet, or a total of $5.67. At the average price of $7.17, he had $1.50 for overhead, profit, and stumpage. However, farmers usually get a little less for their wood than the average paid per cord of wood delivered to the mill. Since the farmers cannot be depended upon to supply wood at any definite time or in any definite quantity and since they are paid cash on delivery, the paper mill maintains a small differential between the local deliveries and the wood obtained under contract from jobbers. The actual margin for this Floodwood farmer, then, was probably about $1.35 per cord. On a similar basis peeled spruce yielded $2.00, balsam fir 50 cents, and aspen 25 cents per cord for stumpage.

A small operator near Wright reported these average costs per cord for 8-inch aspen clothespin bolts in 1935:

Cutting	$1.60
Skidding	.50
Trucking	3.00
Overhead	.50
Stumpage	1.00
	$6.60

A matchwood operator at McGregor reported similar operating costs in 1935, except that he paid $4 per cord for trucking.

The margin is lowest, of course, on conversion wood. At $4.50 per cord delivered, and with trucking costs amounting in most cases to $2.00 or $2.25, the return for stumpage is negligible and the producer of the conversion wood cannot count on more than about 1 cent per stick for his labor. A logger near Moose Lake distributed his costs per cord on jack pine conversion wood approximately as follows:

Logging	$1.25
Skidding	.50
Trucking	2.25
Stumpage	.50
	$4.50

Before farmers can be expected to enter wholeheartedly into a woodlot improvement or management program, they must have some assurance of a net return on the growing as well as on the harvesting of their timber.

Prices for matchwood and the better grades of pulpwood have gradually climbed, and are now substantially higher than in 1935. On the other hand, costs of logging have also increased, so that stumpage returns are still meager.

Taxes

The typical restocking forest area in Minnesota yields yearly only one fifth of a cord an acre, worth 10 to 20 cents at current stumpage rates for cordwood. Unless it has value for other than timber production, a tax of 4 or 5 cents an acre is about all it can stand. Now, however, many such areas are taxed 15 to 30 cents an acre or even more. Of course, if the woodlands can be improved so that they will yield a half cord an acre a year and prices per cord can be increased to an amount that will allow $1.00 to $3.00 a cord stumpage, it is quite possible that sometime in the future this land can carry a tax of 20 to 30 cents an acre a year. At present, such a tax merely discourages holding of the land for any purpose. Hence the excessively large acreage of tax-delinquent land.

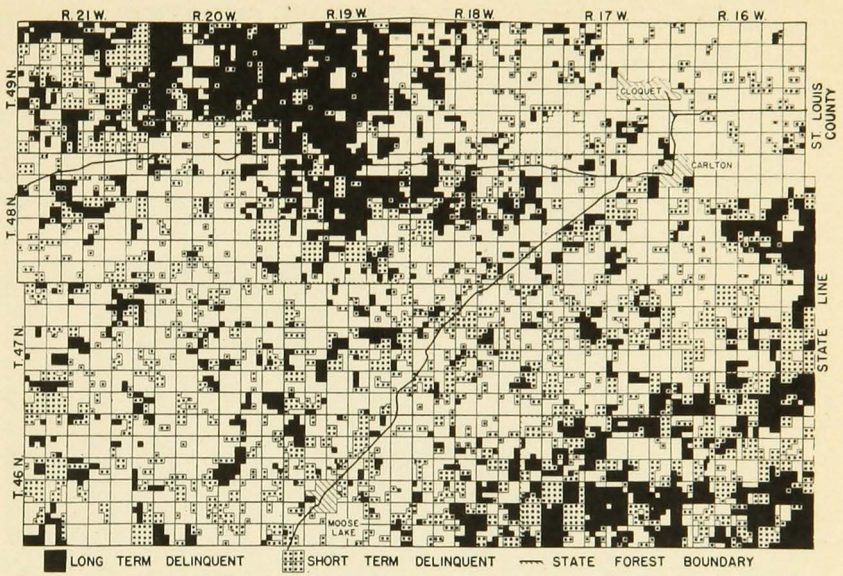


FIG. 12. LANDS IN CARLTON COUNTY ON WHICH TAXES PAYABLE IN 1935 OR EARLIER WERE UNPAID IN SEPTEMBER 1936

Delinquency of five years or more is indicated as "long term." Of the 1,600,000 acres total area tax delinquent in 1936, about 800,000 acres, or 50 per cent, were "long term."

As has been shown, only a little more than one fourth of the land in the district around Cloquet is now in farms. Of the remainder, only a very small portion is as yet in public ownership and under public protection in such projects as the Fond du Lac, Cloquet Valley, Savanna, and Nemadji state forests and the Jay Cook and St. Croix state parks. Most of the wild land is owned by private companies and individuals. Of this privately owned wild land, approximately 1,605,000, or about 50 per cent of the total area of this district, is tax delinquent[6] (fig. 12). Most of this tax-delinquent land is nonagricultural. Much of the tax-delinquent land is expected to revert to the state, as trustee, under the provisions of Chapter 129, Laws of 1927, and Chapter 415, Laws of 1929. In the meantime, the land receives little care from any source and is open to trespass on all sides. As a matter of fact, many of these areas are progressively being stripped of all timber and young growth by unregulated cutting. By the time they are finally incorporated into state forests, they will be practically worthless for early timber production.

[6] On January 1, 1931, 1,305,000 acres of rural land in this district was tax delinquent. (Blakey, Roy G., and associates. Taxation in Minnesota. University of Minnesota Press, 1932.) A recheck made by the Resettlement Administration in Carlton and Pine counties in 1935-36 indicated an increase of about 23 per cent in the intervening 5 years.

MEASURES NEEDED TO IMPROVE SITUATION

Unquestionably, both from the standpoint of the industries and from that of the local farmers, a large share of the logs, pulpwood, and other forest products needed in Cloquet should be furnished from nearby woodlands. The conclusion is inescapable, however, that present trends are leading not toward development of a self-sustaining forest unit but toward eventual destruction of the remaining forest resources. Two

FIG. 13. A CHANCE FOR SELECTIVE CUTTING

From this stand of 45-year-old aspen the largest trees could now be removed for match bolts or pulpwood. Within a few years the smaller aspen left after such a cutting would grow to match-bolt or pulp size. The balsam fir could be marketed as Christmas trees or left to grow into pulpwood.

separate lines of improvement are needed—betterment of the conditions of the forest lands, and improvement in marketing. The matter of first importance is to build up the woodlots—by protection, use of better cutting methods, clearing out of defective timber, and some planting.

What the Farmers Can Do

In both woodlot improvement and marketing improvement the farmers are capable of making some advance on their own initiative.

While few farm woodlots in the Cloquet area contain much mature timber, many support fairly satisfactory stands of young aspen, pine, fir, and spruce. These young stands can be developed rapidly to merchantable size by good protection and proper cutting.

Aspen is now the most abundant woodlot tree in the Cloquet region, and is the species with which most farmers will have to deal. Aspen

Table 6. Potential Yields of Black Spruce Stands on Medium Sites within the Superior National Forest*

Age	Average diameter of dominants	Volume of dominants (unpeeled)
Years	Inches	Cords
30	2.4	1
40	3.2	6
50	3.9	14
60	4.5	21
70	4.9	25
80	5.2	29

* Table by Fox and Kruse, Superior National Forest, 1937.

Table 7. Potential Yields from Spruce Swamps throughout Northern Minnesota*

Age	Saw timber	Additional pulpwood	Total volume
Years	Board feet†	Cords	Cords
40	.....	0.2	0.3
50	.....	1.0	2.1
60	90	2.2	4.2
70	180	4.1	7.6
80	530	6.4	11.8
90	1,300	7.8	14.9
100	2,400	8.8	18.0

* See footnote page 4.
† International Log Rule, ¼-inch sawkerf.

Table 8. Potential Yield per Acre of Jack Pine Stands*

Age	Average diameter	Volume of saw timber	Total volume
Years	Inches	Board feet†	Cords
30	4.0	.....	8
40	5.9	900	18
50	7.6	2,750	25
60	9.0	5,400	29

* See footnote page 4.
† International Log Rule, ¼-inch sawkerf.

Table 9. Potential Yield per Acre of Spruce-Balsam Forests in Northern Minnesota*

Age	Volume of saw timber	Additional pulpwood	Total volume
Years	Board feet†	Cords	Cords
20	.....	0.1	0.3
40	400	1.4	5.6
60	1,400	4.0	14.6
80	3,550	5.2	22.2

* See footnote page 4.
† International Log Rule, ¼-inch sawkerf.

FIG. 14. SUCCESSFUL RE-ESTABLISHMENT OF BLACK SPRUCE BY NATURAL SEEDING UPON RECENTLY CUTOVER SPRUCE SWAMP, FOREST EXPERIMENT STATION, CLOQUET, MINNESOTA

The old spruce was cut in strips, several years elapsing between the cutting of each two successive strips. The cutting moved from east to west.

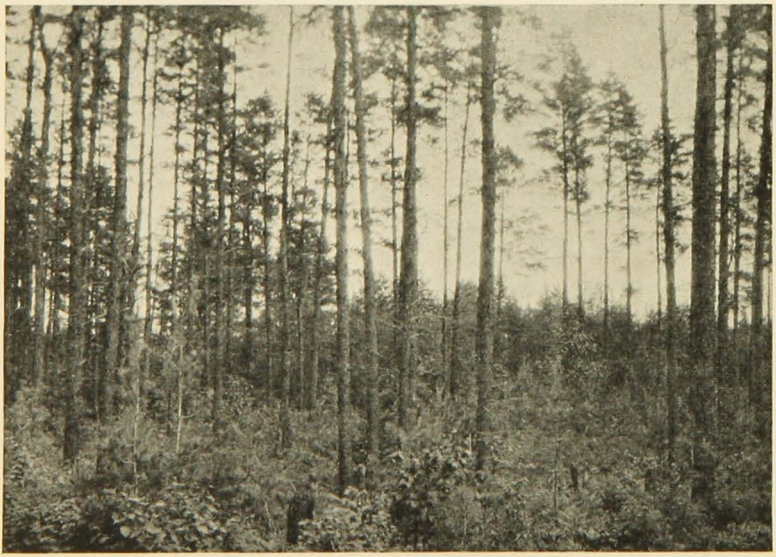


FIG. 15. JACK PINE STAND 54 YEARS OLD ON THE FOREST EXPERIMENT STATION, CLOQUET, MINNESOTA, CUT SELECTIVELY

The trees left will grow to saw log size while a stand of young forest trees is establishing itself underneath them.

reproduces well and grows rapidly. The main requirement is proper cutting and protection from fire (fig. 13).

There are several possible methods of improving yields from spruce swamps. The main point is to avoid premature cutting, prevent fires, and avoid clear cutting of large contiguous tracts. Good results have been obtained in some localities by clear cutting in narrow strips (fig. 14). On some other areas, selective logging is practicable. What method of cutting is best for each spruce swamp situation is a matter that must be worked out with care.

The moderately good sites already stocked with spruce 30 or 40 years old offer a splendid chance to create a really productive forest within 15 to 30 years. The potential yields are shown in tables 6 and 7.

Pine stands are more limited in area but have excellent possibilities of improvement. Jack pine, especially, grows rapidly and can be expected to yield substantial quantities of both saw timber and pulp at 50 to 60 years of age (table 8 and fig. 15). Pine for both lumber and pulp is in steady demand.

Balsam fir is a species for which an increased demand can logically be expected. It is a good pulping wood and grows more rapidly than spruce. Fair yields can be expected at 60 to 80 years of age from the spruce-balsam forests in northern Minnesota (table 9).

Small balsam fir trees in pure stands or mixed with aspen and birch ordinarily should not be cut for conversion wood but should be held until large enough to be cut into pulpwood. Balsam fir trees more than 11 or 12 inches in diameter, however, rapidly become defective and should be utilized for whatever purpose they can serve.

Tables 6 to 9 show why thrifty young stands 30 to 60 years of age should not be slashed down to make conversion wood or a small quantity of pulpwood. A few more years and the farmer can cut saw logs, mine timber, a much larger quantity of pulpwood, and other more valuable products. Pulpwood can be obtained from the tops and from thinnings.

One example will show the possibilities in managing young pine. A farmer near Rush City was about to clear off 2.1 acres of young northern white pine in 1919 when he was induced to give forestry a trial. In 1935 this farmer was able to cut $955.69 worth of logs and firewood from this small tract and to leave a good stand of young timber that will permit another cutting in about ten years.

Hardwood stands other than aspen and birch should ordinarily be cut selectively. The procedure to be followed depends partly upon species and partly upon the markets available for the hardwood material that can be cut.

Marketing

Often the farmer can obtain a greater average price for his product by carefully studying the specifications for the various types of wood required by the industries and sorting his wood accordingly (figs. 16

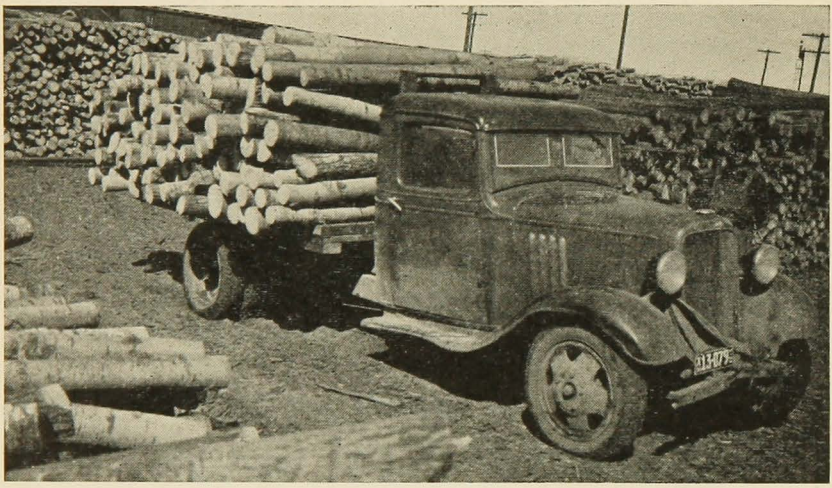


FIG. 16. TRUCKLOAD OF SMALL ASPEN, FOR WOOD CONVERSION PLANT

and 17). A load of aspen made up half of match bolts and half of pulpwood will bring only the price of the latter. Inclusion of substandard wood in any delivery results in heavy culling at the yard and much unnecessary expense in hauling. That some of the farmers in the Cloquet district are already sorting their wood in advance is indicated by the fact that in 1935 about 25 per cent of them divided the sale of their products between two companies, and 11 per cent among all three companies.

Familiarity with current prices for all types of wood products, not only in Cloquet but in the several Wisconsin markets, will help the farmer to cut his wood most effectively and will enable him to take advantage of a strongly competitive situation.

Often a group of farmers can bargain more effectively as to prices and terms of contract than could the individual farmers. In other words, some form of cooperative marketing may prove desirable. At the present time, the farmers who are actively marketing wood are so widely scattered, and the volume of production they control is so limited, that it would seem impractical to attempt any price manipulation by cooperative action. It might, however, be possible to arrange the sale of forest products through existing store cooperatives. This would facilitate preliminary grading and sorting. An organization of the principal producers might be very effective in negotiating standard contracts, speaking for the farmers in any negotiations between lumberjacks and timber operators, keeping members advised as to market conditions, and proposing legislation in the interests of farm forestry.

What the Industries Can Do

For managers of the wood-using industries, who may take as much interest as farmers in improving the condition of nearby woodlands, there are three logical lines of activity.

First, the industries should stimulate better forest practice in the farm woods and on adjoining wild lands. If wood producers would pledge themselves to practice selective logging and to carry out other needed measures of forest improvement, it is believed that the industries would be justified in offering a bonus for the wood so cut. In the long run, local wood will be cheaper and more satisfactory than wood hauled from more distant sources, and unless some tangible inducement is set before the farmers they may be unable or may not think it worth while to introduce the changes that are recognized as necessary.

The second line, in which some progress has already been made, is finding ways of utilizing small aspen and defective trees of other species. The most promising possibilities seem to be in the manufacture of composition boards; new developments in the chemical field are not out of the question.

Third, the industries should participate directly in restoring some of the deforested lands not closely associated with farms. Assuming that some solution of the currently critical tax problem can be worked out, the Cloquet industries might well retain some tracts of productive forest land within 50 or 60 miles of their plants, protect such tracts from fire, and reforest the more promising ones.

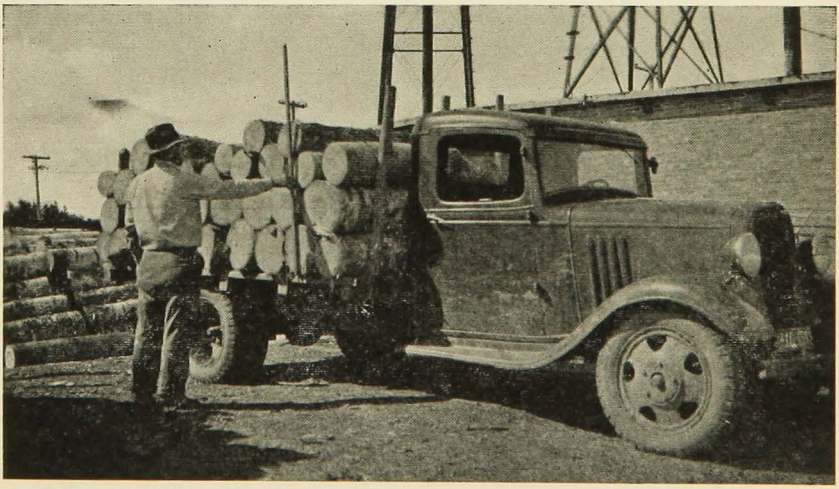


FIG. 17. SELECTED ASPEN BOLTS FOR MATCH FACTORY

What the Public Should Do

While the situation around Cloquet can be greatly improved by voluntary efforts on the part of farmers and of forest industries, results will undoubtedly be much more certain and much more prompt if they are stimulated by public activity.

One of the most valuable contributions the public can make will be in educational and extension work. The Norris-Doxey Cooperative Farm Forestry Act of 1937 authorizes federal aid for the employment of additional forest extension specialists in the various states. But as yet (1938) no funds have been provided by Congress for carrying out this Act. If, when such funds are provided, an additional extension forester could be assigned to this area, he could advise individual farmers on their problems in woods management and in the marketing of woods products. He could carry to the farmers the results of research conducted at the Cloquet Forest Experiment Station, which is located near the center of this area, and by the Lake States Forest Experiment Station. He could advise farmers with respect to subsidies available under the Agricultural Adjustment Act and could help them in the organization and operation of a marketing association. The need for educational work of this character could be taken care of equally well by providing the County Agent with an assistant trained in forestry. The movement to provide such assistance should be encouraged.

Small-scale demonstrations of proper woodlot management are being made by the Civilian Conservation Corps and the Works Progress Administration. More comprehensive demonstrations are authorized under the Norris-Doxey Act. Many problems in woods management can be worked out with the help of farmers on the demonstration woodlots already established or to be established sometime in the future under the Norris-Doxey Act. Under the provisions of this Act, the University of Minnesota Extension Service and the Minnesota Conservation Department are expected to cooperate in establishing one or two demonstration woodlots per township as rapidly as funds become available; and the University of Minnesota, the Lake States Forest Experiment Station, and the U. S. Forest Products Laboratory are authorized to work on the technical forestry problems presented by these demonstration woodlots. These public agencies will also cooperate with the industries in research to promote better utilization of aspen and other hardwoods.

The Agricultural Adjustment Act authorizes the payment to farmers of $2.50 an acre for protecting and improving their woods by thinning, pruning, and removing weed trees. In 1937 some 250 farmers in the Cloquet district took advantage of this proposal, and others will doubtless follow. The companion proposal that offers $7.50 per acre for forest planting is not now operative in northern Minnesota.

Instruction in the phases of forestry pertaining to the management of farm woodlots is now being offered in the high schools of St. Louis

County under the provisions of the Federal Vocational Training (Smith-Hughes) Act of 1917.

The State of Minnesota has established four state forests within the Cloquet district, and if all the tax-delinquent lands within state forest boundaries are permitted to revert, the state will soon have within this district a forest property of considerable magnitude. Most of the land is swamp or recently cutover upland, but parts of it have good reproduction and other parts would be very productive if planted to pine or spruce. The Minnesota Conservation Department has here a real opportunity to demonstrate not only what forestry practices are most desirable, but how public forests can serve to maintain permanent industries, and, by providing part-time employment, to supplement the income of farmers in this part of the state. Probably no other area of public forest in the state could better justify intensive development for these purposes.

The large acreage of tax-delinquent land scattered throughout the farming district offers a more difficult problem. It is not in sufficiently compact blocks to be administered efficiently as state forest. In some cases it is not certain that this land should permanently remain forested. Under present laws, land of this kind reverts to the state as trustee, but county boards can sell or lease it at their discretion, the proceeds going chiefly to local units of government. How can tax-reverted lands be made to fit in with the type of farm-forest development recommended around Cloquet?

There seems to be some merit to the idea of allotting to local settlers and small loggers tracts of from 40 to 640 acres each of scattered tax-delinquent lands that have become public property and lie adjacent to their homes, such settlers or loggers being required to care for the lands and authorized to remove and sell wood therefrom under proper limitations. If the settler undertook to protect the tract from fire and trespass and to build up the forest he might be given a virtual monopoly of the timber to be cut. It would then be to his interest to prevent forest fires and to build up the growing stock. This procedure would have the advantage of interesting some of the local people in the care of the public lands and should simplify the problem of protection and administration of such lands. Ultimately, such tracts might be sold to the farmer and incorporated in his farm. This should lead eventually to establishment of more self-sustaining farm units, upon which forest products would be among the more important crops.

SUMMARY AND CONCLUSIONS

In the Cloquet district of Minnesota, a 3,124,226-acre unit surrounding Duluth and Cloquet, 50 years' prosperity between 1870 and 1920 has been followed by an abrupt decline in the lumber industry and by many difficult adjustments in land use necessitated by too rapid exploitation

of natural resources. This history is typical of the northern Great Lakes cutover region. The Cloquet district differs from the average district of the region in having been more completely stripped of merchantable timber, and in being more favorably situated with respect to markets for farm-woodland products.

Large- and small-scale logging, and extensive and often-repeated burning have severely depleted the forest cover on this area. Very little of the old-growth timber remains. Only 1½ per cent of the originally forested area is in saw timber, and only 9.2 per cent is in cordwood stands. About 747,800 acres, or 32.6 per cent, of the forest area is cutover and not yet restocking. Of the 1,510,900 acres of cutover land that has restocked, 86 per cent is occupied by small aspen, paper birch, jack pine, and immature swamp conifers.

Although 28.4 per cent of the district is in farms, only 9.3 per cent is cropland. Approximately half of the average farm is wooded.

The Cloquet district's sawmills, pulp mills, match factory, and wood-conversion plant can utilize practically any kind and size of wood produced in the district. These mills can use 15,000,000 feet or more of saw logs and now require 125,000 to 150,000 cords of smaller wood a year. Owing to the depleted condition of the forests, they obtain only 40 to 50 per cent of these requirements within the district. Nevertheless, in 1935, some 750 individuals in the district, including 425 farmers, obtained a substantial income by cutting wood and hauling it to the local plants. On the average, each of the farmers who delivered wood to this market brought in 56.2 cords, and received for it $327 in cash. From the nature of the land and the type of farming practiced, it appears probable that farmers in this district will continue to obtain a considerable share of their income by marketing forest products. Under present conditions, they are doing this at great loss of potential growth.

Obviously, it is to the interest of both the timber industries and the farmers that most of the wood used within the district be produced within it. This could be done readily if the available forest acreage were kept in reasonably good condition. The obstacles to development of a self-contained forest unit supported primarily by farm forestry include (1) a tax system unfavorable to forest management, under which about 35 per cent of the total forest area has now been tax delinquent for five years or more; (2) lack of technical leadership in farm forestry; (3) unattractive prices for forest products; (4) farmers' lack of financial resources; and (5) their lack of the form of knowledge and experience required for the rebuilding of their run-down woodlands.

On the basis of the present study, it is recommended that (1) demonstration farm forests be established under the provisions of the Norris-Doxey Act; (2) that forestry instruction, under the Smith-Hughes Act, be provided in high schools serving rural populations; (3) that additional extension foresters be assigned; (4) that a bonus be offered by the local forest industries for wood produced by farmers certified by

extension foresters as giving their woods proper care; (5) that farmers cooperate in sorting, grading, and marketing farm-woodland products; (6) that AAA benefit payments be made for woodland improvement and planting; (7) that title to the lands within the boundaries of the state forests five years or more tax delinquent be taken by the state, that these lands be added to the state forests, and that these state forests be intensively developed; (8) that tax-delinquent lands lying outside the boundaries of state forests be leased to qualified individuals, with safeguards guaranteeing proper management; and (9) that continued efforts be made to bring taxes within the income-producing capacity of the lands.

A well-rounded program of this kind, consistently and aggressively carried on for a period of 20 years, should go far toward restoring the forests in the Cloquet district and toward ensuring the permanence of forest industries now employing more than 2,000 persons and paying more than $2,300,000 annually in wages and salaries.